

The Limits of Prevention

J. MICHAEL MCGINNIS, MD

Dr. McGinnis is Deputy Assistant Secretary for Health (Disease Prevention and Health Promotion), Department of Health and Human Services. This paper is adapted from his presentation at the Prevention '84 Meeting of the American College of Preventive Medicine, Atlanta, GA, April 16, 1984.

Tearsheet requests to J. Michael McGinnis, MD, Deputy Assistant Secretary for Health (Disease Prevention and Health Promotion), Switzer Bldg., Rm. 2132, 330 C St., SW, Washington, DC 20201.

Synopsis

Recent years have been marked by unprecedented accomplishments in preventing disease

BETWEEN 1900 AND 1982, life expectancy at birth increased more than 27 years for Americans—from 47.3 years in 1900 to 74.5 years in 1982 (1). This means that over the century to date, every 3 days the population as a whole increased its life expectancy by about 1 day (Dr. William H. Foege, former Director, Centers for Disease Control, unpublished remarks at Emory University School of Medicine, May 1984). Much of the credit for these unprecedented gains must go to prevention of many of the leading health threats to Americans of all ages (2). Indeed, in recognition of the substantial opportunities inherent in prevention programs, for the first time a comprehensive national agenda for prevention has been developed, with specific goals and objectives for anticipated gains (2,3).

Of course there are limits to what can be expected. These limits must be acknowledged. And to the extent possible, they must be factored into our plans for the recruitment of further health gains through preventive measures.

The forces shaping the nature and the potential of prevention programs can be characterized as points falling along a spectrum ranging from the purely scientific to the purely social. This paper focuses on four points along that spectrum and discusses some of the limitations to prevention that are presented by biological factors, technological factors, ethical factors, and economic factors.

and reducing mortality. More gains can be expected, but there are limits. The forces shaping the nature and potential of prevention programs can be characterized as points falling along a spectrum ranging from the purely scientific to the purely social. This paper focuses on four elements of that spectrum, discussing some of the limitations to prevention that are presented by biological, technical, ethical, and economic factors. The author concludes with an essentially optimistic perspective on the prospects, special opportunities, and imperatives inherent in each of the categories of limitations discussed.

Biological Limitations

The issues that may perhaps be most fundamental in scientific terms are those relating to the biological limitations on prevention's potential. Among these issues, the most fundamental question is that of the actual limit of the human lifespan and the extent to which it may be subject to alteration. If a person is brought into this world in a disease-free environment, is provided an optimal developmental milieu that nurtures him or her to full physiological and psychological potential, is protected from trauma, and is spared by a benign deity from the ravages of chronic disease, how long will his or her biological clock continue to tick? And what will be the nature of his or her decline?

In the past, questions of this sort have elicited conjectural—almost spiritual or metaphysical—responses. But now there is a growing body of scientific information that places the biological limit of the human lifespan somewhere between 80 and 110 years, assuming no alteration in chromosomal structure. Friese claims it is about 85 (4a). Walford puts it at more than 100 (5). But it does seem to be a reasonably fixed span that has remained fairly constant over centuries.

Our *life expectancy* has, of course, increased rather faithfully as conditions and interventions against diseases have improved. The remarkable

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27-year increase in life expectancy at birth that has occurred in this country alone bears powerful witness to that fact. But human *lifespan* is a different issue. Friese and Crapo summarize the issues nicely in their 1981 book "Vitality and Aging" (4).

The longest human life that has been documented is 114 years, in spite of tales of supercentenarians from the Caucasus in Russia, the mountains of northwestern Pakistan, and the Andes Mountains of Ecuador. In fact, the 1980 "Guinness Book of World Records" validates only five persons as having lived past 112 (4b). If we therefore assume that 114 years—the age of longest recorded life—is an approximation of man's maximum life potential and a record reached by a very small set of statistical outliers, we are forced to consider the likelihood that a finite lifespan has been built into the genetic code of the human species.

Confirmation of this hypothesis comes from a variety of sources. Hayflick, for example, in studying cell divisions in human fibroblasts, found that the cell lines—which might have been expected to continue to divide indefinitely, given a constant milieu—consistently ceased to divide after about 50 doublings (6). Something intrinsic in the nature of those fetal cells, and totally independent of exogenous factors, gave them a self-contained mortality.

This observation is consistent with studies by Shock which indicate that our major organ systems—the heart, lungs, kidneys, and so forth—each have a sizable functional reserve that allows them to decline gradually without causing any overt problems (7). Theoretically, it is only when the limits of these reserves are reached naturally, or depleted through the assault of some disease, that people fail and die.

In studies of a completely different sort, Cutler used anthropological data, on ratios of brain size to

body weight, from 85 mammalian species to calculate the maximum lifespan of *Homo sapiens* and related ancestors. The results suggest that, whereas *Homo habilis* and *Homo erectus* (living 500,000 to 1.5 million years ago) had predicted lifespans—not actual life expectancies—of only 60 years or so, for the last 100,000 years the predicted lifespan has remained relatively constant, at about 90 years, for *Homo sapiens* back through *Homo neandertalensis* and *Homo europaeus* (8).

Efforts to evaluate the human lifespan have also offered some interesting lessons to use in our efforts to enhance prospects of attaining the lifespan that is possible—lessons important for all prevention professionals. An example is the classic work of McCay, who found that the surest way to prolong the lives of laboratory rats was to restrict their caloric intake (9).

Indeed, epidemiologic studies of those populations that have done best at maximizing their potential indicate with reasonable consistency the merits of diets low in calories and animal fats, particularly coupled with high levels of physical activity sustained well into old age. But, in the final analysis, while much has been learned about and accomplished in increasing human life expectancy, to date no diets, lifestyles, drugs, or vitamins have been found to increase lifespan (4). In prevention, we are dealing with certain fundamental biological limits to our efforts.

Technological Limitations

Related to the issue of biological limits to prevention is that of technological limits, gaps that exist in our technological armamentarium for addressing contemporary health problems. It is important to emphasize the word "contemporary" because these are today's limits; the boundaries of tomorrow, with advancing technology, are unknowable.

There certainly are many examples of problems for which prevention offers limited prospects today. For example, we often speak glowingly of the end of infectious diseases as threats to human health, but the fact is that serious problems still exist. Globally, the infectious disease malaria has perhaps the most profound impact on human health. Before the turn of this century, Sir Ronald Ross identified the mosquito as the source of malaria, but today half the world's population is still at risk. The World Health Organization estimates that there are 150 million active cases worldwide and, in Africa alone, about 1 million deaths a year (10). Today, 30 years after talk of eradicating malaria, and some impressive gains in

the 1960s, transmission of the disease is again increasing greatly—and in some places is virtually unchecked. We have not yet been able to overcome the technical challenges of controlling malaria.

In this country, the disease that is perhaps most frequently discussed today is acquired immune deficiency syndrome—AIDS. Cases of the disease were first reported in 1981. To date, this awful scourge has afflicted nearly 10,000 people in this country. Those who have it are rendered defenseless against an inexorable decline to death.

On the chronic disease front, while dazzling gains have been achieved in the last decade or so in preventing deaths from cardiovascular disease, and while we've also witnessed some societal changes with respect to smoking and diet that can leave us hopeful about cancer prevention, we nonetheless have few clues to help us prevent some of our most prominent chronic sources of morbidity.

Arthritis, for example, is a complaint of 25 percent of people 45 to 64 years old—and 44 percent of people over 65 (11). About one-fifth to one-third of those afflicted have rheumatoid arthritis, a severely disabling disease that we have no possibility of preventing, given current knowledge.

Alzheimer's disease is another example. It has been estimated that this problem afflicts more than 1.5 million people in the United States each year, causing more than 100,000 fatalities. Among people over age 80, the age-specific incidence is about 5 percent per year; the age-specific prevalence, about 25 percent (12). We know only that with the disease there occurs in the brain a typical neurofibrillary degeneration with plaques and a depletion of acetylcholine. We haven't a reliable clue about how to prevent it.

For childhood-onset diabetes, insulin helps, but how can the disorder be prevented? And what are we to do about preventing osteoporosis, multiple sclerosis, glaucoma, hearing disorders, Crohn's disease, and a host of other sources of infirmity in our society?

Beyond the technical limits we face in preventing the decline attendant on various acute and chronic physiological assaults, there are the greatest technological challenges of all: stemming the rising contributions of trauma and violence to our mortality tables. Today, three of the five leading causes of potential years of life lost in this country are not directly related to disease. They are homicide, suicide, and accidental injury. There is no common solution to these problems, and our inability to address them effectively is a striking indication of the technological limits to today's prevention efforts.

Ethical Limitations

The third set of factors to be considered in pondering the limits of prevention relates to ethical limitations. This is a dimension that cannot be taken lightly, in view of the increasing emphasis given to the need for people to change their lifestyles to stem the diseases that sap so much of society's resources.

Inherent in the very word "prevention" is the concept of formal action of a restrictive nature. And when prevention is a national priority, questions must be asked about the role of the government that is implementing those restrictions. What is the legitimate scope of government's interest, and which of government's instruments of enforcement ought to be applied?

Discussions of the nature of the common good, and of the reasonable limits of action to achieve it, are as old as civilization itself. Policymaking in a free society must be a delicate balancing act between laws and regulations and court decisions to protect the whole society, on the one hand, and guarantees to protect the rights and decisionmaking options of individual persons, on the other.

This balancing act has to be particularly judicious in matters of public health. Efforts to prevent disease and promote health get us into areas that affect individual citizens in much more personal ways than do decisions about tax policies or foreign trade or national defense. Disease prevention and health promotion involve decisions affecting not only a person's pride and pocketbook but also his or her body, soul, and psyche.

The justification for societal action to protect the public's health is, on the face of it, somewhat more publicly palatable when that action is directed at a commercial concern and deals with preservation of a healthy environment or guarantee of a safe product. Even these issues of environmental protection and product safety are not without some manner of impact on individual freedoms. Public uproar is certainly not uncommon in response to efforts to improve air quality by restricting the use of home fireplaces or the burning of trash in back yards. And there are considerable costs for the implementation of automobile safety measures—costs that are, in the final analysis, passed on to be paid unknowingly by consumers.

But the principal issues related to justification of social action for health are those derived from health promotion—efforts to change personal behavior on behalf of our national health profile. What kinds of food we eat, how much we drink, whether

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we smoke, how much we exercise, what our sexual habits are, all have a powerful impact on our health prospects. These are choices we have to make as individuals, and generally their direct impact is on us as individuals—not on others.

The most compelling question society must address relates to the basis and the boundaries of public jurisdiction over private behavior. The issues are easiest to address, but not uncontroversial, in areas where the behavior of some people impacts directly on the well-being of others. Examples include driving while intoxicated, transmitting a venereal disease, or exposing nonsmokers to tobacco smoke. Such problems are society's first obligations, although when they relate to individual behavior, there is a special obligation for ensuring the strength of the scientific evidence motivating the action taken.

Much more complex are actions that are undertaken on economic grounds. Social programs to provide special rewards or penalties for certain kinds of personal behavior are often justified on the grounds that attendant on certain behaviors are sizable social costs. An example is the recent analysis that every pack of cigarettes sold costs society \$3 for health care and loss of productivity (13). Currently, these costs are spread throughout society and borne largely by nonsmokers. Many people naturally feel that equity demands a redistribution of the burden more directly to the perpetrators. But there are other equity issues as well, pulling in the opposite direction. The social-structural model of health behavior holds that it is the least advantaged in our society who engage in unhealthy behaviors, because they lack legitimate elements of informed choice available to others. Hence, economic penalties fall more heavily on those groups and only compound the inequity (14). The issues are complex.

There are also questions of the scope of activities, the value structure implicit in the activities, and society's right to impose a particular set of values on its citizens. Choice of a particular lifestyle—for example, one that assigns a very high priority to physical and emotional fitness—derives from a certain defined set of values and beliefs. When a social program indicates that a particular set of choices is desirable or preferable, it is opting for a particular value system. When it further prompts the encouragement of the value system at schools, at work-sites, and through community organizations, it is marshalling substantial forces on behalf of its preferences.

This is not to imply that programs fostering behavioral changes are suspect or pernicious. On the contrary, we have an obligation to help people enhance their own health prospects. But we have to realize that when formal social actions are proposed to influence people's attitudes—and particularly when it is proposed that the tools of state be deployed to achieve this influence—those actions will be interpreted against the backdrop of our tradition of rugged individualism, for better or worse. Consequently, the issue of the propriety of these actions must be addressed conscientiously and carefully. Indeed, considering the ethical dimension of prevention programs is not only a social obligation but a strategic necessity.

Economic Limitations

One of society's central ethical dilemmas is the distribution of its resources; hence, closely related to the ethical limits to prevention is the issue of economic limits. There can be no question that our economic resources for investment in prevention are constrained. A cartoon captures this problem fairly well. It is of a forlorn-looking Ziggy, standing on a street corner behind a tin cup set out for donations. Over one shoulder is a large sign that says, "There must be some mistake."

That is doubtless the way many feel when pondering society's expenditures for prevention. At the Federal level, a popular figure used is 4 percent of all health expenditures. In fact, it is probably somewhat more than that, if the budgets of the Environmental Protection Agency, the Consumer Product Safety Commission, the Occupational Safety and Health Administration, the nutrition programs of the Department of Agriculture, and the health-effects programs of the Department of Energy are factored into the calculations. Regardless of the calculus, the expenditures are small

compared with the potential gains in many areas. This is particularly true with respect to prevention's role in the delivery of health services. In decisions on reimbursement for health services, a sort of dual standard often is applied to treatment services vis-a-vis preventive services. This seems to be true whether the third-party payer is private or governmental.

To be eligible for reimbursement, a treatment service must only be shown to be reasonably effective in addressing a given problem. For a preventive service, on the other hand, not only must an ironclad argument be marshalled as to its effectiveness in achieving the desired result, but also it must be shown that the cost of delivering the service is less than the cost of treating the condition prevented. The flaw in this equation is obvious. No value is given to the state of better health achieved for the person served by preventing a disease. Oftentimes still other tests are applied to questions of reimbursement for preventive services: proof that people who live longer as a result of prevention efforts (for example, influenza immunization) will not accrue health costs later in life to offset the treatment savings, or even that pension benefits attendant on a longer lifespan will not be excessive.

If the standards for treatment and prevention services were equivalent, under the current rules for prevention a candidate for surgical bypass to treat coronary artery disease would, for example, first face the following questions:

- Have you proven that this procedure is less expensive than a rigorous diet, exercise, and smoking cessation program?
- If you are kept alive because of this procedure, will you guarantee never to use the medical system again as long as you live?
- Will you also promise never to draw a cent of your pension in these extra years we're giving you?

It is perhaps not unreasonable for society to place a higher priority on addressing the most immediate problems, but the economic criteria used for decision do not appear to be offering the appropriate incentives to improve the yield of human potential for the nation. They present very real limitations for prevention efforts.

Prospects and Opportunities

Having discussed the various limits to prevention, it is only appropriate to conclude with an essentially optimistic perspective on the prospects

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and on the special opportunities and imperatives inherent in each of the categories of limitations that have been discussed. They will be taken in reverse order.

On the issue of economic limits, it is important that we not allow ourselves to be caught in the trap of defending prevention programs on the ground that they will enrich the national coffers. These programs should be supported on their health merits, which are themselves quite substantial. Analyses that seek to identify returns for investment are not in themselves objectionable, but, for public policy purposes, those analyses ought to focus on health returns and include a comparative component. Every investment has an opportunity cost of sorts. Prevention will stack up well, compared with treatment, when assessed in terms of returns to health, and those analyses should be encouraged.

We ought also to anticipate some fairly sizable additions to the resources available to prevention, as new participants such as employers and community agencies become involved, and as we gain more knowledge about the effectiveness of interventions under consideration for reimbursement purposes.

Regarding the question of the limitations imposed by moral and ethical issues, it is indeed important to accord this dimension prominence in the planning of prevention programs. But in formulating an ethics of health promotion, perhaps the most important feature to factor in as an explicit topic is the role of the ethics of *inaction*. What are the ethical issues involved in *not* sharing with the public the consensus of scientific understanding with respect to smoking or diet or toxic substances? What are the ethical implications of *not* invoking societal action against known toxic agents? What of society's choice to employ a less effective intervention, rather than a more effective one, because of political sensitivities—for example, taxation for cigarettes and alco-

hol? These are matters of at least equal claim to a place in the ethics of prevention.

Regarding the limits imposed on prevention by the available technology, one hardly strains for myriad examples of the pace at which changes are occurring:

- A team in New York has recently found that inserting a small piece of DNA from a herpesvirus into the large vaccinia virus yields protective antibodies against the piggybacked agent. This opens up a whole new realm of possibilities for production of vaccines, including a vaccine against malaria.
- As to AIDS, identification of HTLV-III, a variant of human T-cell leukemia virus, as the probable cause of the disease has already led to development of a blood test to detect antibodies to HTLV-III and may quite possibly lead to development of an effective vaccine.
- Research on the endorphins as neurotransmitters is yielding startling new insights into brain physiology—to the extent that we may be on the verge of identifying the molecular structure of man's motives.

The list of advances grows with each passing moment. On the matter of technologies, the surest thing we can say is that the limits of today will become the opportunities of tomorrow.

Finally, with respect to biological limits, we cannot expect that we will be able to change the lifespan itself. One thing is certain, however, and that is that we still have much to gain in helping people attain their rightful endowment—and attain it in a healthy fashion. We're doing quite nicely in approaching the 1990 goals for the nation of reduced mortality for people at every life stage (2). But we need to be sure that our attention is also turned to ensuring that as people move closer to the limits of their lifespan, they do so in a healthier and healthier fashion. This ought to be fully within our grasp.

As Ashley Montagu has said, the highest goal in life is to die young, at as old an age as possible (15). This is our charge—and our opportunity.

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